Patent Claims

1. Electrical heating device (10) for hot runner systems, in particular for hot runner manifolds and/or hot runner nozzles (12), comprising at least one insulating layer (20) and at least one heating layer (22) having heating conductors (23), the layers (20, 22) which form a flat layer heater being applied by direct coating in an adherent manner onto at least one wall (16) of a mold mass flow tube (13) associated to a flow duct (14).

2. Device according to claim 1, wherein at least one insulating layer (20) is a vitreous or ceramic dielectric layer which after at least one baking process is under pressure pretension relative to the wall (16) that is associated to the flow duct (14).

3. Device according to claim 1 or claim 2, wherein the linear thermal expansion coefficient (TEC_{DE}) of the baked dielectric layer (20) is smaller than the linear thermal expansion coefficient (TEC_M) of the wall (16) that is associated to the flow duct (14).

4. Device according to claim 3, wherein the difference between the linear thermal expansion coefficients (TEC_{DE} - TEC_M) amounts to at least 5.0 10^{-6} K^{-1}.

5. Device according to any one of claims 1 to 4, wherein the dielectric layer (20) comprises a system of vitreous crystalline materials.

6. Device according to claim 5, wherein the system of materials comprises at least one preformed glass adapted to wet at a predetermined baking temperature the surface of the wall (16) which preferably is of metal and to thus assume at least partially a crystalline state.

7. Device according to claim 5 or claim 6, wherein the system of materials comprises at least one further glass which does not become crystalline under predetermined baking conditions.

8. Device according to any one of claims 5 to 7, wherein the system of materials comprises at least one compound which is crystalline a priori.

9. Device according to any one of claims 5 to 8, wherein the dielectric layer (20) is a baked-on foil.

10. Device according to any one of claims 5 to 8, wherein the dielectric layer (20) is a baked-on thick-film paste.

11. Device according to claim 10, wherein the solid components portion of the thick-film paste consists exclusively of a glass that crystallizes in situ at a temperature range above 900 °C.

12. Device according to any one of claims 5 to11, wherein the linear thermal expansion coefficient (TEC_{DE}) of the dielectric layer (20) is between $5 \cdot 10^{-6}$ K^{-1} and $7 \cdot 10^{-6}$ K^{-1}.

13. Device according to any one of claims ~~5 to~~ 12, wherein the dielectric layer (20) includes a gap in a longitudinal direction of the wall (16) of the flow tube (13).

14. Device according to any one of claims 5 to 13, wherein the heating layer (22) includes heating conductor strips (23) adjusted to the power demand.

15. Device according to claim 14, wherein at least one electrically insulating cover layer (24) is deposited on the heating layer (22).

16. Device according to claim 15, wherein at least one interlayer (26) is provided below and/or between the dielectric layer (20), the heating layer (22) and the cover layer (24).

17. Device according to any one of claims 14 to 16, wherein there is at least one further layer (28) whose resistance depends on the temperature of the heating layer (22) and/or of the wall (16).

18. Device according to claim 17, wherein the resistor layer (28) forms a thermo-element.

19. Device according to any one of claims 14 to 18, wherein the resistor layer (28) and the heating layer (22) lie in one plane.

20. Device according to claim 19, wherein the insulating layer (20), the heating layer (22), the cover layer (24), the interlayer (26) and the resistor layer (28) are baked-on foils or baked-on thick-film pastes.

21. Device according to any one of claims 14 to 20, wherein the insulating layer (20), the heating layer (22), the cover layer (24), the interlayer (26) and the resistor layer (28) form a layer compound.

22. Hot runner system, in particular hot runner manifold or hot runner nozzle, comprising a heating device according to any one of claims 1 to 21.

23. Hot runner nozzle comprising a heating device according to any one of claims 1 to 21, the heating device being fixed onto a cylindrical flow tube (13), a rod, a manifold branch, a nozzle or the like.

24. Method for manufacturing a heating device (10) for hot runner systems, in particular hot runner manifolds and/or hot runner nozzles (12), wherein at least one insulating layer (20) and at least one heating layer (22) having heating conductors (23) are directly coated in an adherent manner onto at least one wall (16) of a mold mass flow tube (13) that is associated to a flow duct (14).

25. Method according to claim 24, wherein at least one insulating layer (20) is a ceramic dielectric layer.

26. Method according to claim 24 or claim 25, wherein the heating layer (22) includes heating conductor strips (23) of whatever shape.

27. Method according to claim 26, wherein at least one electrically insulating layer (24) is deposited on the or each heating layer (22).

28. Method according to claim 27, wherein at least one interlayer (26) is deposited below and/or between the dielectric layer (20), the heating layer (22) and the cover layer (24).

29. Method according to claim 28, wherein at least one further layer (28) is deposited or inserted whose resistance depends on the temperature of the heating layer (22) and/or of the wall (16).

30. Method according to any one of claims 24 to 29, wherein each of the layers (20, 22, 24, 26, 28) is separately deposited using foil technology, thick-film technology or screen printing.

31. Method according to claim 30, wherein the layers (20, 22, 24, 26, 28) are deposited using thick-film technology by way of pastes applied in a round-about printing process.

32. Method according to claim 30 or claim 31, wherein each of the layers (20, 22, 24, 26, 28) is separately deposited and is subsequently baked-on.

33. Method according to claim 30 or claim 32, wherein all the layers (20, 22, 24, 26, 28) are separately deposited and are simultaneously baked-on by co-firing.

34. Method according to claim 32 or claim 33, wherein the firing temperature is between 800 °C and 1,100 °C.

35. Method according to any one of claims 24 to 34, wherein at least the dielectric layer (20) is provided with a gap in a longitudinal direction of the wall (16) of the flow tube (13).

36. Method according to any one of claims 24 to 35, wherein the wall (16) to be coated consists of a hardened or solidifiable material.

37. Method according to claim 36 or claim 37, wherein the firing temperature of any of the layers (20, 22, 24, 26, 28) does not exceed the hardening temperature of the wall material.

38. Method according to claim 36 or claim 37, wherein the process of hardening the wall (16) is performed during at least one of the firing processes.

39. Method according to claim 38, wherein the firing conditions are adjusted to the hardening temperature.

40. Method according to any one of claims 24 to 39, wherein the wall (16) of the hot runner nozzle (12) is inductively heated to hardening and/or firing temperature.

41. Method according to any one of claims 24 to 40, wherein at least one insulating layer (20) is a ceramic dielectric layer and wherein during the firing process, a pressure pretension is produced within this layer relative to the wall (16) that is associated to the flow duct (14).

42. Method according to claim 41, wherein a specific mismatch is made of the linear thermal expansion coefficient (TEC_{DE}) of the dielectric layer (20) relative to the linear thermal expansion coefficient (TEC_M) of the wall (16) that is associated to the flow duct (14), depending on the expansion-relevant characteristics of said wall (16), the linear thermal expansion difference (TEC_{DE} - TEC_M) amounting to at least $5.0\ 10^{-6}\ K^{-1}$.

43. Method according to claim 41 or claim 42, wherein the linear thermal expansion coefficient (TEC_{DE}) is between $5.0\ 10^{-6}\ K^{-1}$ and $7.0\ 10^{-6}\ K^{-1}$.

44. Method according to any one of claims 41 to 43, wherein the dielectric layer (20) is produced by firing a system of vitreous-crystalline materials onto the wall (16) that is associated to the flow duct (14), said material system comprising at least one pre-formed glass which, at the respective firing temperature, wets the metal surface and at least partially assumes a crystalline state.

45. Method according to claim 44, wherein the system of materials comprises at least one further glass which does not become crystalline under firing conditions.

46. Method according to claim 44 or claim 45, wherein the system of materials comprises at least one compound that is crystalline a priori.

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